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3. Circulation Stage

This consists in sending goods to the storehouse and to market and ends with the receiving of payment. In this stage, working capital is embodied in finished goods, cash, transfers, and bank accounts. The faster the working capital changes from one form to another, the less capital is needed by an enterprise. If the turnover of working capital is slower than the established ratio because of the accumulation of a large inventory and many raw materials, the enterprise will face great difficulty in making payments.

The amount of working capital required by an enterprise is computed on the basis of the actual conditions of the preceding year, previous experience, and the plan for the current year. Many difficulties in computing the necessary amount of working capital have been due to lack of sufficient and reliable historical data. Therefore, the following method has been devised to help those who are responsible for planning.

A. Computing Necessary Working Capital in the Preparation Stage

The working capital necessary for the preparation stage consists mainly of basic, subsidiary, and expendable raw materials, tools, implements, etc. Its amount depends on: (1) the amount of these materials used up in the production stage, (2) the frequency of raw material purchase, and (3) conditions of supply and demand. If the plant purchases materials daily, materials should be stocked for only one day's use. If the plant purchases materials once every 2 weeks, then a 2 weeks' reserve should be made. The supply and demand conditions for raw materials include transportation, geographical distance from the sources of materials, storage, etc.

We should compute accurately the days of reserve in accordance with the above-mentioned factors. There are two methods for making this computation.

1. Assuming that 50 percent of the basic production materials are obtained from Source A, 30 percent from Source B, and 20 percent from Source C, and assuming that it takes 20, 18, and 17 days, respectively, to get these materials from A, B, and C to the plant for entrance into the production process, then the total number of days required for the material reserve is $(0.5 \times 20) \text{ Plus } (0.3 \times 18) \text{ plus } (0.2 \times 17)$ or 18.8 days.

This is a rather simplified example. More accurate computation should proceed with the computation of each type of production material. The total of the individual computations will be the days of reserve for the plant as a whole.

2. Days of reserve serving as a basis for computing necessary working capital may be derived from previous data.

The working capital needed for each type of raw material must be computed separately, and is equal to the product of the daily consumption and the number of days that it takes to replace the consumed raw material. The working capital for tools, implements, and miscellaneous items which are in use regularly is computed in the same way. Computation for those materials which are not used regularly must be based on the actual consumed amounts and their conditions of supply and demand.

For example, if the complete preparation stage requires 18 days, and the annual consumption of the basic raw materials is 2,372,500,000 yuan or 6,500,000 yuan daily, the raw materials would tie up a working capital of 6,500,000 multiplied by 18, or 117 million yuan in the 18-day period. Since delays or interruptions often occur in the raw material supply, a safety margin should be

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set up in terms of percentage of the normal reserve. In the above example, if the safety margin is 20 percent of the normal reserve; then the actual working capital should be 117 million yuan plus $(0.2 \times 117,000,000)$ or a total of 140,400,000 yuan.

According to the above example, a working capital of 140,400,000 would assure the continuous operation of a plant which has an annual consumption of production materials of 2,372,500,000 divided by 140,400,000 or 16.9. Each turnover takes 365 divided by 16.9, or 21.6 days. Since the safety margin is equal to 2 percent of the normal reserve, one turnover actually requires 18 plus 0.02 multiplied by 18, or 21.6 days.

$$\text{Days of reserve} = \frac{\text{Days in the total production period}}{\text{Rate of turnover}}$$

$$\text{Rate of turnover} = \frac{\text{Total expenditure}}{\text{Average production material inventory}}$$

$$\text{Average production materials inventory} = \frac{x_1 + 2x_2 + 2x_3 + \dots + x_n}{2(n-1)}$$

Assuming the monthly production material inventory, taken at the beginning and the end of each month last year, to be as follows:

Month	Inventory at Beginning of Month (1 million yuan)	Inventory at End of Month (1 million yuan)
Jan	10	
Feb	11	11
Mar	12	12
Apr	14	14
May	10	10
Jun	12	12
Jul	11	11
Aug	13	13
Sep	15	15
Oct	12	12
Nov	11	11
Dec	13	13

Assuming the total expenditure on production materials to be 180 million yuan, and n equal to 13, then:

Yearly average production material inventory equals $\frac{10 + (2 \times 11) + (2 \times 12) + (2 \times 14) + (2 \times 10) + (2 \times 12) + (2 \times 11) + (2 \times 13) + (2 \times 15) + (2 \times 12) + (2 \times 11) + (2 \times 13) + 10}{24} = 288/24 = 12$ (million yuan).

$$\text{Rate of turnover} = 180/12 = 15$$

$$\text{Days of reserve} = 365/15 = 24.3 \text{ days}$$

B. Computing Working Capital in the Manufacturing Stage

Working capital in the manufacturing stage refers to capital invested in all finished and semifinished goods in the manufacturing stage from the bringing of raw materials into the plant, through the processing of the goods, to

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their storage. The amount of the working capital in this stage is determined by the costs of raw materials and the length of the manufacturing period. The higher the costs and the longer the manufacturing period, the more working capital is required.

If the total production expenditure is 372,300,000,000 yuan per year, then the expenditure is 372,300,000,000 divided by 365, or 1,020,000,000 yuan per day. If the manufacturing stage takes 5 days under the present technical standards, the working capital invested in the goods in process would amount to 1,020,000,000 multiplied by 5, or 5,100,000,000 yuan. Actually the working capital is less than this amount since raw materials are used gradually in the production process. In other words, goods in process do not tie up the entire working capital. Therefore, we may be able to find the ratio of the working capital to the total cost of production by determining first the composite production factors, or the relationship each productive factor bears to the total cost of production, and second by determining the nature of the particular production process -- whether it is simple or complex.

To compute the average accumulated input of production materials is a rather complicated matter. The following example is given on the basis of previous statistics and this year's production plan.

Assuming that the whole production process requires 5 days, production materials are applied in accordance with the following schedule:

<u>Production Period</u>	<u>Production Materials Input in % of Total</u>	<u>Accumulated Input (in %)</u>
1st day	50	50
2d day	20	70
3d day	10	80
4th day	10	90
5th day	10	100
		390

The production material input per day is expressed in percent of the total input during the production period. The average accumulated input of production materials in our example is equal to:

$$390/5 = 78 \text{ (78 percent)}$$

This method of computation applies to other types of input.

Assume the average material input ratios for the following materials and expenses: indirect raw materials 0.71, fuel and power 0.81, wages (including basic wages, bonuses, overtime pay) 0.55, engine room expenses 0.50, and general expenses 0.50. The weight of the various materials and expenses in the total costs are: basic materials 45 percent, indirect materials 8 percent, fuel and power 1.5 percent, wages 9.5 percent, engine room expenses 16 percent, and general expenses 20 percent. The average accumulated input of the total production expenses equals the total of the weighted average accumulated input of various production expenses:

Basic production materials	$0.78 \times 0.45 = 0.3510$
Indirect raw materials	$0.71 \times 0.08 = 0.0568$
Fuel and power	$0.81 \times 0.015 = 0.01215$

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Wages	$0.55 \times 0.095 = 0.05225$
Engine room expenses	$0.50 \times 0.016 = 0.00800$
General expenses	$0.50 \times 0.20 = 0.1000$
	1.00 0.6522

In our previous example we calculated that goods in process would tie up a working capital of 5,100,000,000 yuan. This means the average accumulated input of all production factors is equal to one. Now we have found that this is not the case, since all the production factors are not applied at once. As shown in our computation, the average accumulated input of all the productive factors is 0.6522. Therefore, we only need a working capital of 5,100,000,000 yuan multiplied by 0.6522, or 3,326,220,000 yuan, in order to maintain continuous operation.

The formula is as follows:

Working capital invested in unfinished goods equals the daily production expenses multiplied by days of the production period multiplied by the rate of the average accumulated production material input; or

$$\frac{372,300,000,000}{365} \times 5 \times 0.6522 = 3,326,220,000 \text{ yuan}$$

A safety margin is also necessary in view of the fact that production operation sometimes is interrupted by shortage of materials, by mechanical troubles, power troubles, etc. Assuming the safety margin to be 20 percent of the normal working capital, the total necessary working capital for goods in process is 3,326,220,000 multiplied by (1 + 0.2) equals 3,991,404,000 yuan. The computation of working capital requirement may be more accurate if the enterprise breaks down the production process into several stages and computes the costs at each stage.

1. Goods in Process

If we substitute the "average accumulated input application of the productive factors" by "costs of goods in process in percentage of the total production costs," we will obtain the working capital invested in goods in process:

Working capital invested in goods in process equals the daily production costs multiplied by days of the production period, multiplied by the costs of goods in process in percent of the total production costs.

As to the costs of goods in process in percent of total production costs, this may be obtained by previous cost accounts from various production stages. Thus:

Costs of goods in process in percent of total costs equal inventories of the goods in process in different stages of production divided by daily production costs multiplied by days in the production period.

If the output is large, the daily production costs are large, and the inventories at various stages are also large. Daily production costs and inventories of goods in process at various stages move up and down together. What we have to do is to take an inventory of goods in process and find out the total costs of production per unit of goods.

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The unit cost of goods in process per day equals the unit cost of finished goods multiplied by the days of production period.

The inventory of the goods in process per day equals the inventory of goods at the first production stage, plus the inventory of goods in the second stage, plus etc. equals the unit cost of goods in the first stage, multiplied by the days of production in the first stage plus the unit cost of goods in the second stage multiplied by the days of production in the second stage multiplied by the days of production in the third stage, plus etc.

The cost of goods in process in percent of the total production costs is equal to the inventories of unfinished goods at various stages per unit of finished goods per day divided by the costs of per unit of goods in process per day.

2. Semifinished Goods

Semifinished goods are intermediate goods, the inventory of which depends on the production quantity of the finished goods. Thus:

The quantity of semifinished goods used daily equals the average daily output of the finished goods multiplied by the semifinished goods in each unit of finished goods.

Working capital invested in semifinished goods equals the daily inventory of semifinished goods multiplied by the days for making reserve multiplied by the unit cost of the semifinished goods. It can also be computed from previous data on the basis of costs at various stages. The average number of days required to build up a reserve of unfinished products is determined by the existing technical level. Unnecessary inventory usually occurs in the case of semifinished goods. This is mainly because of the technical limitations, the shortage of replacement parts, machine troubles, etc. The accumulation of inventory of unfinished goods calls for additional working capital. It seems necessary that a safety margin be added to the working capital necessary for semifinished goods.

C. Computing Working Capital in the Circulation Stage

Capital which is tied up in the period after the goods are produced and before they are sold is known as working capital in the circulation stage. Since the various state-owned enterprises have adopted independent accounting systems and since payment is usually made on delivery, the industrial plant may calculate its working capital requirements on the basis of the inventory of finished goods. The working capital is equal to the product of the average daily output multiplied by the price per unit (wholesale price or official price used in transfer) and multiplied by the average number of days required to maintain the inventory. The latter should be estimated from actual sales conditions; for instance, the time required for packing and filling of orders, nature of the product, the frequency of production orders, and the conditions of storage. We may use the same method by which we compute the days of reserve for raw materials to compute the days of inventory period.

Therefore, in computing working capital requirements, we should use the methods that are suitable to the actual conditions. We should economize on the use of working capital, aiming at maximum efficiency. We should not let production be interrupted for lack of working capital. Sound management of working capital will lay the foundation for more effective industrial management.

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